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ORIGINAL ARTICLE

Is the post-human a post-woman? Cyborgs, robots, artificial intelligence and the futures of gender: a case study

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Abstract This study aims to shed light on the debate about the futures of gender, by taking into account its significance in the current development of Artificial Intelligence (AI), cyborg technologies and robotics. Its reflections are sustained by empirical data obtained between November 2010 and January 2011, when the author engaged in a study related to Gender and Artificial Intelligence at the Department of Cybernetics, University of Reading (England) under the supervision of Professor Kevin Warwick, known as the first human cyborg for his experiments "Cyborg I" (1998) and "Cyborg II" (2002). In this context, the author formulated a questionnaire which was answered by more than one hundred students and researchers of the Department. The specific question motivating this research was: how and to what extent do gender and the intersectional differences characterizing the human species inform the development of cyborgs, robots and AI? The results of the questionnaire, presented in this article, offer original and controversial perspectives on how such epistemological approaches may impact the futures.

Keywords Gender · Artificial intelligence · Robot · Posthumanism · Transhumanism · Kevin Warwick · Feminism · Future Studies · Embodiment · Technology · Design

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Introduction

This article addresses the relation between gender, technology, embodiment and possible futures. More specifically, it focusses on two questions: how are the epistemological approaches adopted in the fields of Artificial Intelligence, cyborg technologies and robotics, going to impact the futures of gender? And vice versa, how and to what extent do gender and the intersectional differences characterizing the human species inform such developments? "Artificial Intelligence is free of the boundaries of gender difference". This opinion, articulated by a student of the University of Reading (England), is a common perception within the field of Cybernetics: since AI operates out of the sexual paradigm, the notion of gender has become obsolete. Such a viewpoint may be part of the story, but is it a definitive answer? In order to cope with these issues, between November 2010 and January 2011 I engaged in a study related to Gender and Artificial Intelligence at the Department of Cybernetics, University of Reading, with Professor Kevin Warwick, one of the world's pioneers in cyber technology. In this context, I formulated a questionnaire which was answered by more than one hundred students and researchers from the Department. The questionnaire was conceived not only as a key to better understand which gendered path the current technological imagination is embracing, but also what consequences such epistemological choices may imply in the long term. The futures do not appear out of nowhere: they are based on the presents, the pasts, and the ways they are being envisioned. As Eleonora Masini has stated: "visions make it possible to create a future that is different from the present although its seeds are in the present" [47]. To think about the futures might contribute to their emergence. This is why it is particularly relevant to engage in how the futures are actually being conceived, and note whether they still hold sexist [50], racist [16] or ethnocentric biases [56].

Posthumanism offered me the theoretical frame to engage in this study. Its field of interest stretches from the critique of humanism and anthropocentrism (7), to roboethics and the evolution of the species, as it necessarily relates to Futures Studies. Informed by Social Constructivism [41, 42] and Feminist Epistemology,[1] among other reflective frames, Posthumanism is aware of how science is a constitutive aspect of the human cultural domain, and shares its situated beliefs and inherited biases. The perception of knowledge as a performative process constantly reshaping itself, radically differs from a fixed notion based on an objective reality that only needs to be discovered. Such a processual perception of knowledge production was emphasized in the humanities through the postmodern shift, and has been differently engaged upon by the "hard" sciences. Actually, one could argue that a major input for such a reformulation came from the field of Physics, starting with the theory of general relativity [19], passing through Quantum Mechanics.[2] However, at present, scientists and philosophers generally work separately on related subjects, only to meet each other in the battlefield of bioethics. Reflecting on gender within a posthuman paradigm, I saw the need to create a dialogue with the researchers directly involved in designing some of the technological futures. Such a move generated a highly productive exchange. Before presenting the results of my investigation, I will introduce the work of Kevin Warwick, to better comprehend why I decided to focus my research in this specific direction.

Kevin Warwick

Kevin Warwick is known to be the first human being to have a microchip inserted in his body; he has also been considered the first cyborg, because he used the technologies currently available not only to restore lost human functions (such as sight, hearing, or motor action of a limb), but to enable new capacities that no human had previously experienced. Warwick gained worldwide notoriety through the series of experiments known as "Project Cyborg" (1998–2002). In the first one "Cyborg I" (1998), he inserted a microchip under the skin. The signal was picked up by a computer on his arrival to the building of Cybernetics, at the University of Reading; it was set to open doors, turn on the lights and read his e-mails. The second and most famous experiment dates back to 2002, when a one hundred electrode array was surgically implanted into the median nerve fibres of his left arm. The implant connected Warwick's nervous system to the internet, producing a series of ground- breaking results. For instance, while based at Columbia University (New York), he was able to control a robotic arm placed at the University of Reading [71]. A crucial aspect of the experiment was the attempt to create a form of technological telepathy or empathy, using the Internet to communicate signals. In order to pursue this outcome, another simpler array was implanted into the arm of Warwick's wife, Irena Warwick, culminating in the first purely electronic communication between the nervous systems of two human beings. The results broke new ground regarding the ways the interface between humans and computers could be conceived. In Warwick's words:

> "I was born human./This was merely due to the hand of fate acting at a particular place and time. But while fate made me human, it also gave me the power to do something about it. The ability to change myself, to upgrade my human form with the aid of technology. To link my body directly with silicon. To become a cyborg - part human, part machine. This is the extraordinary story of my adventure as the first human entering into a Cyber World; a world which will, most likely, become the next evolutionary step of humankind". [71]

Such cutting-edge results carried a consistent amount of ethical issues. Aware of it, in 2006 Warwick founded FIDIS ("Future of Identity in the Information Society"), a team focussed on ethicbots - that is, the ethical aspects of cyborgs and robots -, and the future of identity, based at the University of Reading. Intrigued by his research, in November 2009 I went to Vienna specifically to meet with Professor Warwick at the Conference "Android and Eve," held at the Institute of Molecular Biotechnology. His lecture aroused great interest and major concerns. In particular his statement: "Human beings are destined to be a subspecies" caused controversy. In his view, machines are going to become more intelligent than humans, at least those humans who will not merge more dramatically with technology [70]. In philosophical terms, I found particularly relevant the fact that Warwick was posing into question a fixed notion of the human, emphasizing instead its dynamic and constantly evolving side. Furthermore, his research was not calling for an abandonment of the human body in favor of the promise of immortality through virtual existence, common in AI and transhumanist rhetorics. He was engaged in the merging of the flesh with the machine; in other words, he was already thinking like a cyborg. Let's take a step back.

In Western Philosophy, the re-inscription of the body in the knowledge paradigm was enacted in the 20th century by different schools of thought - notably Phenomenology in the first half of the Century, and Feminism and Critical Race Theory, among others, in the second half. Still, the field of Artificial Intelligence, as well as Transhumanism, is largely marked by the dualistic cartesian split of mind/body. AI

[1] I will delve into Feminist Epistemology specifically in section 2.3.

[2] Think, for instance, of the principle of the wave-particle duality [73]. First proposed by Louis de Broglie (1892–1987) in 1924, it can be defined, in the words of physicist Lee Smolin, as "a principle of quantum theory according to which one can describe elementary particles as both particles and waves, depending on the context" [59].

pioneers such as Marvin Minsky and Hans Moravec have presented the biological body as something to be overcome. For instance, in his classic study significantly entitled "Mind Children" (1988), Moravec stated: "What awaits is (…) a future which, from our present vantage point, is best described by the words 'postbiological' or even 'supernatural'" [51]. In his "Society of the Mind" (1985) [49], Minsky totally dismissed the role played by the body in the constitution of the mind, reducing to the brain any biological kinship. Following the same approach, transhumanist thinkers generally present mind uploading (the hypothetical process of transferring a conscious mind from a brain to a non-biological substrate), as a possibility which will be actualized in the near future with no significant loss. Such a prevision genealogically stands as a cyber twist to the dualism which has been structural to the hegemonic Western tradition of thought: the symbolic flesh (a.k.a. body/material/female/black/nature/object etc.) shall be overcome by the symbolic data (a.k.a. mind/virtual/male/white/culture/subject etc.) .[3] Technology is often portrayed as an external source which might guarantee humanity a place in post-biological futures, thus dismissing this crucial point: in ontological terms, technology is not other-than-human. Humans are technological beings, both in their constitutive processes, as well as in their biologies. Warwick's experiments are significant in this regard. For instance, when the implant was taken off his arm, there was no sign of infection. On the contrary, vessels had grown all around it: the body had recognized the chip as its own [71]. The successful results of his work are connected to the fact that Warwick, different from other AI researchers, perceives technology as an embodied process. In his words:

> "What is of considerable interest now, and will be even more so in the future, is the effect of the body on the intellectual abilities of the body's brain. Ongoing research aims at realising an AI system in a body - embodiment[4] - so it can experience the world, whether it be the real version of the world or a virtual or even simulated world. Although the study of AI is still focused on the AI brain in question, the fact that it does have a body with which it can interact with the world is seen as important". [72]

His standpoint allows him to take full advantage of what, in design terms, has been defined as the most sophisticated machine, that is, the biological body; it also grants him the possibility to expand the field of his enquiry. Since 2005, Warwick is involved in the development of biological AI, defined as "a form of AI realised by growing biological neurons" [72]. In his practice of merging the flesh and the machine through embodied narratives, in his scientific approach which empirically dismisses the separation of biology and technology in an evolutionary perception of species, I see the feminist potentials of his vision.

Post-Man or post-woman?

"Human" is a situated concept, in the sense that not every human being has been considered as such. If the human is not a comprehensive notion, of which human is the posthuman a "post"? Is it a post-woman? A post-man? Before elaborating further, I would like to make a note on the ways the notions of "post-human" and "post-woman" have been employed in the title of this study. Let's start by focussing on the second term: "post-woman". It has often been stated that there is no Woman, but there are many different women. As Rosi Braidotti clearly explains:

> "The factual element that founds the project of sexual difference, namely, the critique of Woman as a sign of devalorized otherness, is not biological, it is biocultural, that is to say, historical. Its importance lies in the fact that it allows me and many women like me in the sameness of our gender—all differences taken into account—to state that "we" women find these representations and images of us highly insufficient and inadequate to express our experience. This recognition founds a feminist subject position: feminists are the post-Woman women". [8]

"Post-woman" has to be intended here as the singular form of such an extended notion (that is, the "post-Woman women"). It is now time to clarify that the term "posthuman", in this article, shall not be confused with the notion of the transhuman, nor with the notion of the posthuman as elaborated within the transhumanist discourse, even though it does not dismiss them either. In a previous article [21], I have outlined how Transhumanism and Posthumanism are two movements which cannot be assimilated, although they both reflect on possible futures, share the notion of technogenesis [30], and see technology as a trait of the human outfit. For some transhumanists, human beings may eventually transform themselves so radically as to become "posthuman", a condition which will follow the current transhuman era. Such a take on the posthuman is relevant to this article, but it is not exhaustive. This study employs the term "posthuman" by embracing the post-anthropocentric and post-dualistic approach of (Philosophical, Cultural and Critical) Posthumanism. Posthumanism, in this acception, has been rightly defined as a post-humanism and a post-anthropocentrism [9]; I would like to stress it, more generally, as a post-centralizing as well: a "post" which is constantly

[3] The specific parallel flesh/female and metal/male has been well investigated [7].
[4] Bold in the text.

opening possibilities and does not comply with hierarchical ways of thinking [20].

Currently, the future reflected upon in the West is mostly a technological one. As Ziauddin Sardar remarks: "Technological trends dominate the business of forecasting. The future is little more than the transformation of society by new Western technologies" [57]. Such a questionable preference comes with a set of disadvantages, not only from a post-hierarchical perspective. Feminist and womanist studies have widely exposed the racist and sexist frame within which the discourse on *techne* has been formulated. Judy Wajcman, the founder of Techno-Feminism, already in 1991 noted how only specifically gendered types of technologies are referred as such: "The very definition of technology, in other words, has a male bias. This emphasis on technologies dominated by men conspires in turn to diminish the significance of women's technologies, such as horticulture, cooking and childcare" [69]. The predominant male presence in technological fields is a related aspect, although the generic concept of "men" is not exhaustive either, as Eileen B. Leonard, echoing the critiques offered by postcolonial and critical race theorists, pointed out: "Since minorities are systematically steered away from technology, it has become a major instrument of *elite* male domination" [44].

The feminist debate on technology generated in the Nineties, at first mirrored the one on science,[5] which developed with the rise of Feminist Epistemology and produced outstanding approaches, such as the Standpoint Theory, Strong Objectivity and Situated Knowledges.[6] And still, technology, in its commitment to the making of artifacts (which could be physical as well as virtual), radically differs from science. Deborah G. Johnson has noticed: "The materiality of the human-made world is something that has not been fully addressed by feminism" [35]. Corporeal Feminism [8, 23, 38] which developed in the mid-to-late Nineties, set the theoretical premises for the rise of New Materialism [14, 17], a recent feminist approach within the posthumanist theoretical scenario, which seems to fulfill the necessity outlined by Johnson. New Materialism perceives matter as a process of materialization, developing a notion of agency which exceeds the anthropocentric paradigm.[7]

Before proceeding to the next section, there is one more aspect I wish to highlight: the specific gendered outfit of technology. Since artifacts are created outside of sexual reproduction, it may seem obsolete to think on technology through the gender paradigm. And still: bodies matter even in their disembodiment [3, 37]. In her groundbreaking work "How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics" (1999), Katherine Hayles has sharply articulated:

> "The body is the net result of thousands of years of sedimented evolutionary history, and it is naive to think that this history does not affect human behaviors at every level of thought and action". [29]

Histories and herstories of the human body are herstories and histories of the cyborgs: future generations of humans, post- humans and intelligent machines will have to process them, in order to access a deeper understanding of themselves. Gender, matter, technology, possible futures… When I engaged in my research with Professor Warwick, I had in mind crucial questions, such as: was the ontology of the cyborg being investigated in gendered terms? Were cybernetic developments mainly pursuing paths which had been historically associated with a white male symbolic domain, giving primacy to rationality and logic, rather than affect and matter? And, in the long run: had this kind of questions any relevance at all in the evolution of the species?

Questionnaire "Artificial Intelligence and Gender"

Methodology

There are many issues related to methodology and contents, when conceiving a questionnaire. My purpose was to highlight the relation between sex and gender, as biological, cultural and symbolic frames, and the development of technological futures. After attending lessons and developing a dialogue with the students I was going to interview, I realized that most of them were not familiar with Gender Studies or Feminism. I consulted with Professor Warwick; we agreed that the best results would follow the questionnaire being formulated in the most direct and accessible way. Although aware of the postmodern and queer criticism of the traditional female/male binary, the questionnaire employs it as a cultural and symbolic reference, which in no way is to be accounted in an essentialist manner. I would also like to note that race and ethnicity were directly addressed in one question only; a much deeper investigation is still needed in this particular respect. Here, I wish to clarify that I will not offer a sociological analysis of this survey. Instead, this article relies on the empirical data in order to develop a cultural discursive platform to reflect upon "the seeds" of the futures which are in the present, to go back to Masini. Based on the four approaches crucial to foresight, as outlined by Sohail Inayatullah [33], my approach will take upon the second and the third one, that is, the interpretative

[5] As Wajcman has pointed out:

> An initial difficulty in considering the feminist commentary on technology arises from its failure to distinguish between science and technology. [69]

[6] I will delve into these perspectives in section 2.3.

[7] Karen Barad, for instance, coined the notion of agential realism [4].

and the critical approach, and will not delve into the first (predictive) or the fourth approach (participatory action).

The questionnaire was articulated in eleven questions, administered to first year students, third year students and Ph.D. candidates, and answered by more than one hundred interviewees at the Department of Cybernetics, University of Reading (England). As displayed in Figs. 1 and 2, the gender of the respondents was mostly male, reflecting the current percentage of the students of the Department, as well as the predominant gender of the students enrolled since the beginning of the Program in 2004. The average age was in the early twenties. The prevalent ethnicity was English Caucasian, but a consistent number of students had different ethnic and national backgrounds. Note that, here, I will only focus on the results related to seven of the eleven questions, in order to concentrate on the crucial topics which surfaced. However, I am including the complete list below for scientific transparency. Consider that minor differences would have been applied to the questionnaire if submitted to first year students, third year students or Ph.D. Candidates.

1. When you think of a cyborg, do you think in terms of he/she/it/none?
2. When you think of a robot, do you think in terms of he/she/it/none?
3. Do you think gender has any role in the production of AI?*
4. Do you think there is any difference if a robot is conceived by a male or by a female scientist?*
5. Do you think of gender as a significant category in the future?*
6. Do you think that the new interaction between humans and AI will change the gender balance?*
7. Do you think that one of the two biological sexes will be more advantaged by the creation of AI?*
8. Would you consider relevant to address gender in any of the academic courses related to AI?*
9. Can you think of any experiment in AI where the gender difference would be valuable?
10. Do you think concepts such as race and ethnicity will be significant in the development of AI?*

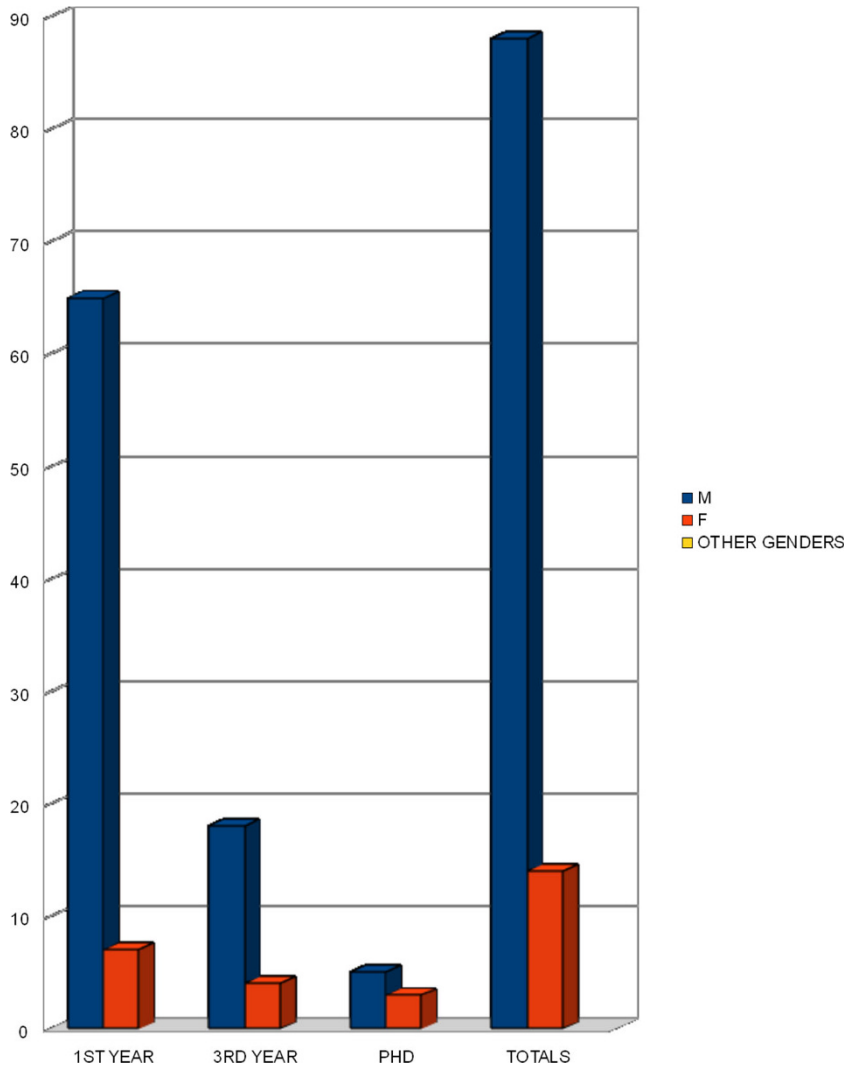

Fig. 1 Gender of the Interviewees

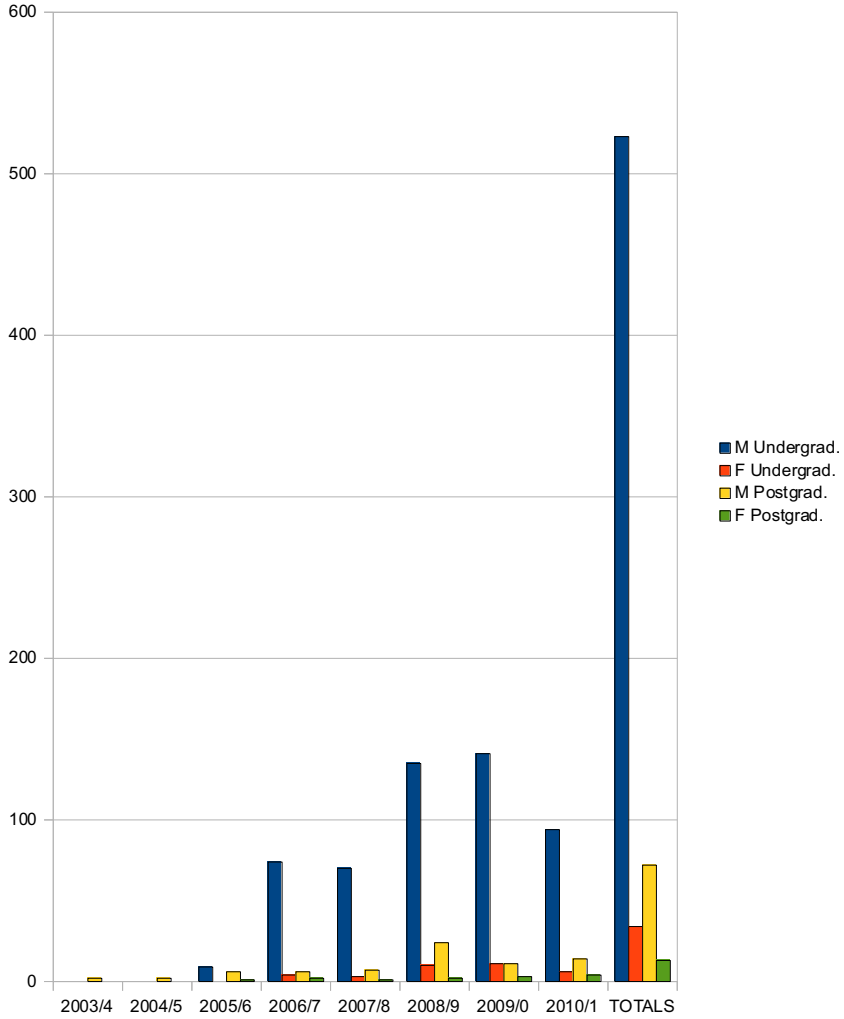

Fig. 2 Gender of Undergraduate/ Postgraduate Students Department of Cybernetics, University of Reading, 2004/2010

11. Why are you interested in Artificial Intelligence?

*Questions 3/4/5/6/7/8/10 were further formulated in "Can you briefly explain why?", to provide qualitative data, as well as quantitative. This is the reason why the next section, based on questions 1 and 2, does not present open answers. For all the other sections, I will quote the comments which were most common or most original, in order to maximize the understanding and use of the results to reflect upon the "seeds" of the futures.

Cyborgs and robots

While posing these two questions, I wished to unveil the gendered terms in which the students were thinking of their projects. The results of the questionnaire placed a clear emphasis on male characters: while the cyborg was thought of as neutral or male by the large majority, out of more than one hundred interviewees, no-one thought of robots in feminine terms, as we can see in Figs. 3 and 4. The historical and cultural dimension of technology is a crucial issue, when it comes to a proper understanding of such an unbalanced result. Science and technology are not only performed, they are first imagined. In Albert Einstein's words: "Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world" [68]. Envisaging the future does not create the future per se, but it may influence the way people perceive it, and ultimately perform in the actual constitution of reality. In the words of Masini:

> "Visions are linked to people who carry the seeds of change, and are not mere abstraction. The ability to nurture the seeds of change and develop visions is even more important than the capacity for future analysis".[47]

Imagination is not separated from cultural, social and political contexts, although it can transcend them. Alison Adam, in her extensive work "Artificial Knowing" (1998) provides a sustained critique of AI, arguing that "the knowing of women (…) is left out of AI's thinking

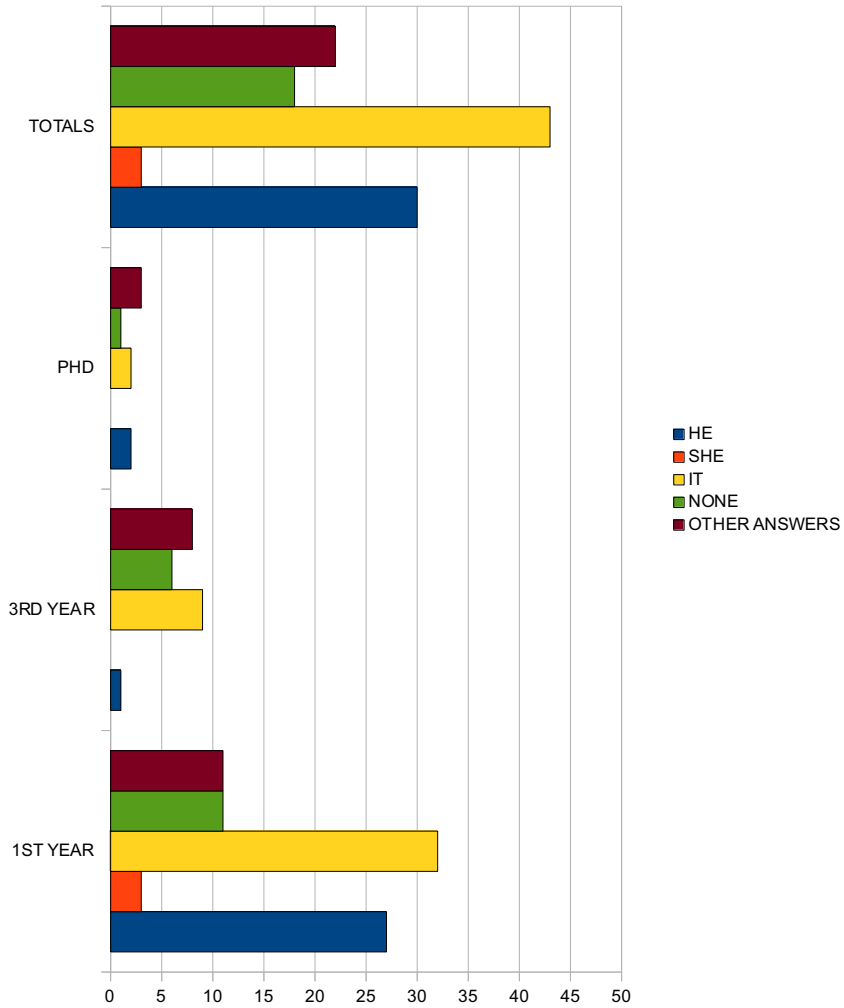

Fig. 3 Question 1: When you think of a cyborg, do you think in terms of he/she/it/none?

machines". [1] If the genealogy of knowledge silently informing AI is reduced to a male legacy, social exclusivism and biological essentialism may be re-inscribed in its ontology, with the consequent risk that the difference characterizing robots may be assimilated in human-centric practices of assimilation; parallelly, it may turn into a stigma for new forms of discriminations based on how far such a difference can be placed from the human norm. Posthumanism, the Philosophy of Sexual Difference, Feminist Epistemology, Subaltern Studies and Intersectionality, among other critical frames, offer crucial insights on how to develop emphatic approaches in the interaction with different forms of known and hypothetical entities. Such standpoints, arising from the "others" of the traditional subject of the Western hegemonic discourse, deconstruct the theoretical necessity of the symbolic other/the mirror/the speculum,[8] offering crucial hermeneutical tools in dealing with the singularian[9] multiplication of onto-epistemological differences.

Feminist epistemology and AI

In the Nineties, the feminist debate on science produced outstanding approaches, labelled under the encompassing term of Feminist Epistemology. The Standpoint Theory [25, 27], which arose amongst theorists such as Dorothy Smith, Donna Haraway, Sandra Harding and Patricia Hill Collins, emphasizes the starting point of knowledge production. Each human being views the world from a specific standpoint, which is informed by their embodiments, social and cultural structures, religious beliefs, spacetime, among other factors. Within this frame, the pursuit of disembodied neutral objectivity, traditionally claimed by scientific practice, is seen as a rhetorical move which has historically benefited those who claimed it. Technology and science are not free from sexist,

[8] I am referring to the symbolic use of this word, as employed by Luce Irigaray in "Speculum, of the Other Woman" (1974) [34], where the woman is seen as the absence which can be filled with male projections: she is not just a mirror, but a concave mirror, a speculum.

[9] The adjective is employed here in relation to the Technological Singularity [40].

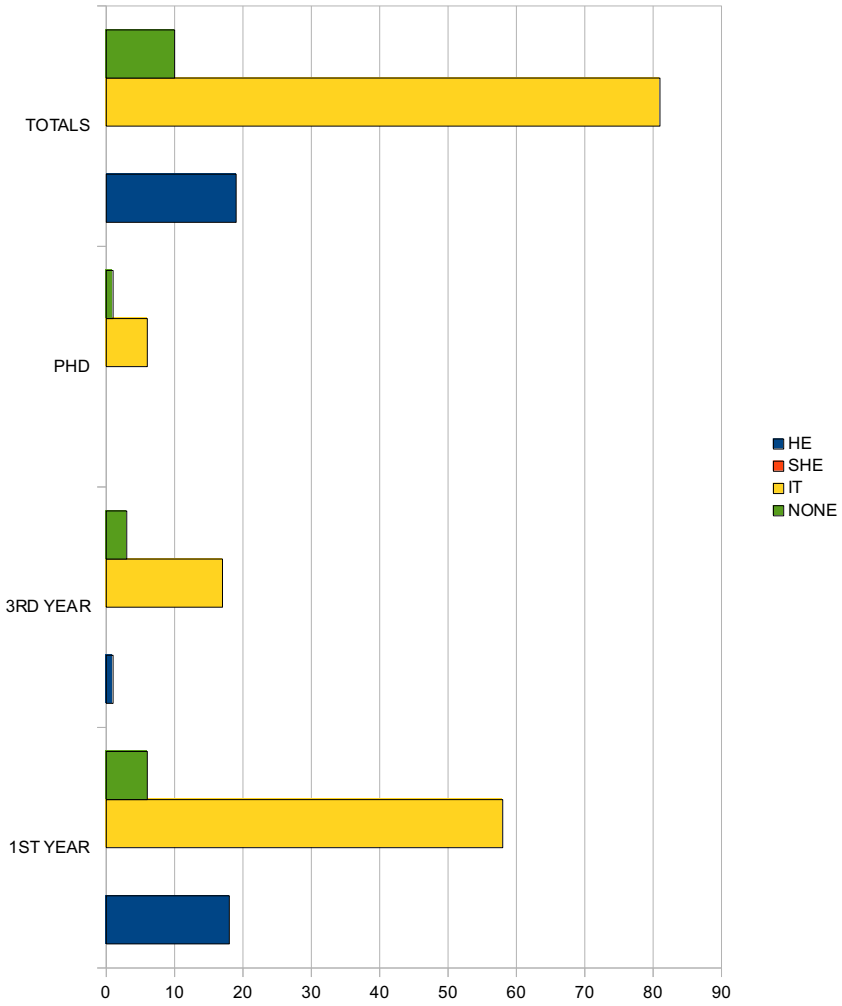

Fig. 4 Question 2: When you think of a robot, do you think in terms of he/she/it/none?

racist and Eurocentric biases; their social construction is embedded in their methods and practice. Objectivity, on the other end, is situated and embodied; in Haraway's words: "Feminist objectivity means quite simply *situated knowledges*" [25]. Since marginalized and/or oppressed individuals and groups must learn the views of those who belong to the hegemony, while the ones located at the center of the hegemonic discourse are not required to learn about the margins, they can be considered bicultural, and their perspectives may be seen as more objective. This specific claim developed into the notion of "strong objectivity" [28]. Feminist Epistemology sets the constitutive frame for the development of posthuman epistemological approaches. The formation of questions 3 and 4 was informed by these theories. Before proceeding further, I would like to remind the reader that, from question number 3, the questionnaire was further formulated into open answers; some of these will be quoted anon.

The results were mixed, displaying a variety of perspectives, as shown in Figs. 5 and 6. Some of the reasons given by respondents as to why they answered "Yes" are: "More males seem interested in AI" and "Robots made by females will probably look nicer". The first answer exposes a crucial aspect which has already been addressed in this article. The second emphasizes design as one of the markers of the gender difference in technology. This viewpoint, which is very common, has received a number of criticisms by feminist thinkers. Linda L. Layne, for instance, presents a specific example to make her point: when some manufacturers realized that they had designed their phones for men, and not for people, they simply thought about altering the design. Through Genevieve Bell's colorful definition [6], she refers to it as the "shrink it and pink it" [43] approach: when it comes to include gender in new technology, the first input is simply to change the color to more vivid ones. On one side, such an attitude can be perceived as a reduction and an assimilation; on the other, it is important to notice that design is crucial in the reception of technology by users - think about the centrality of notions such as accessibility and usability in the making of technology - and that the color change is not a neutral passage when accessed in the frame of psychological and socio-symbolic dynamics.

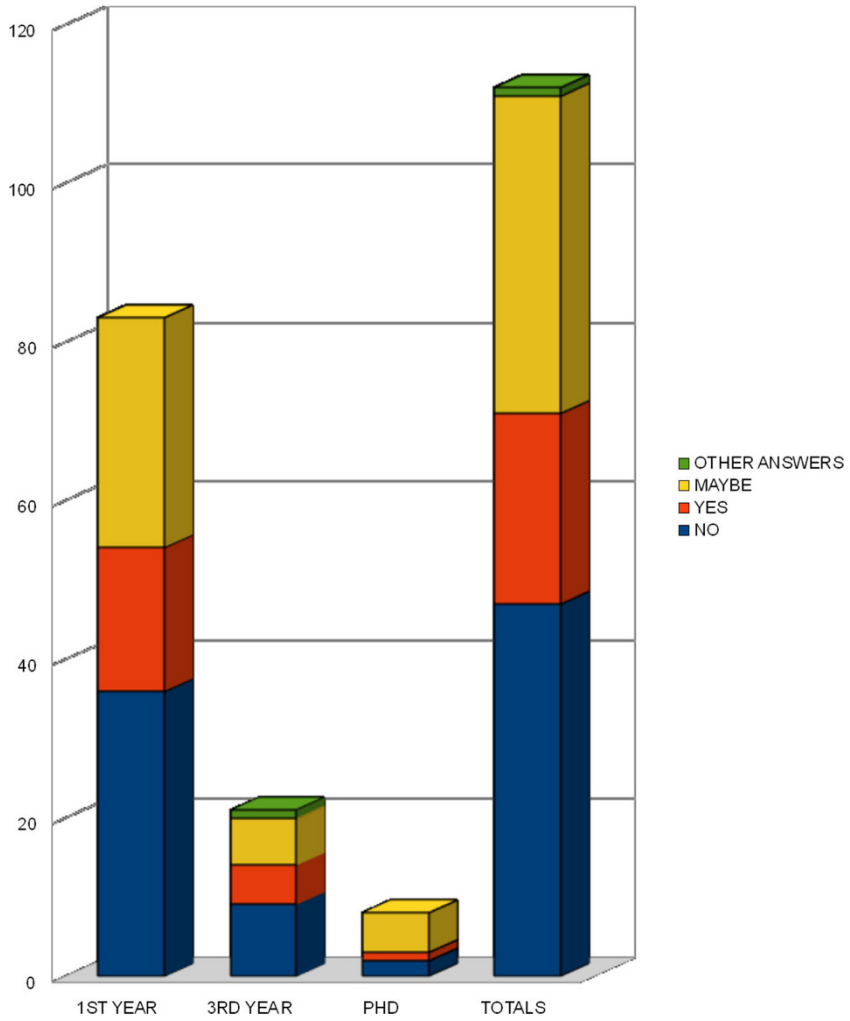

Fig. 5 Question 3: Do you think gender has any role in the production of AI?

Another answer to question 3 was: "When machines become more autonomous and can more clearly define their identity, gender might be important because society might find it easier to accept them". Such reflection emphasizes gender identity as a social code which will resist its biological legacies. Let me explain this further. If gender has been historically constructed around the sexual difference, now that no biological nor sexual motives are connected to the genders of the robots, gender finally proceeds in its raw hermeneutical vestiges. In other terms: even if sex will have no biological or physiological significance for robots, gender - its cultural apotheosis - will still be valuable for humans (at least in the near future), in order to relate more easily with our robotic significant others. In their series of experiments, Clifford Nass and Youngme Moon [54] have illustrated how people tend to relate to computers in the same way they would relate to other humans, including keeping the gender stereotypes and biases untouched, when the robot is given a female or a male voice.[10] To make humans at ease with robots, roboticists apply features which do not have any function other than reception. For instance, the simulation of emotion through various facial expressions, vocalizations, and movements by the robot Kismet,[11] was performed for the sole purpose of engaging the human audience. The range of affects involved in the human/robotic interactions are a subject of ongoing research in different fields: from Robopsychology, a specific form of psychology applied to robots, to Affective Computing, the branch of computer science focused on the development of artificial emotions. Philosophically, these fields of enquiry are related to the contemporary interest in the Affective Turn, which, developed out of Spinozian reminiscences, focusses on how affects affect the social, political, economical and cultural realms, and their affective relations [12].

Let's now focus on the reasons given by respondents who answered "No" to this question, who offered a variety of interesting insights. For instance: "I don't think AI is exclusively the pursuit of replicating human intelligence and therefore is free of the boundaries of gender

[10] See specifically the section "Over-Use of Categories" [54].

[11] Kismet was created by Dr. Cynthia Breazeal at MIT in the late 1990s.

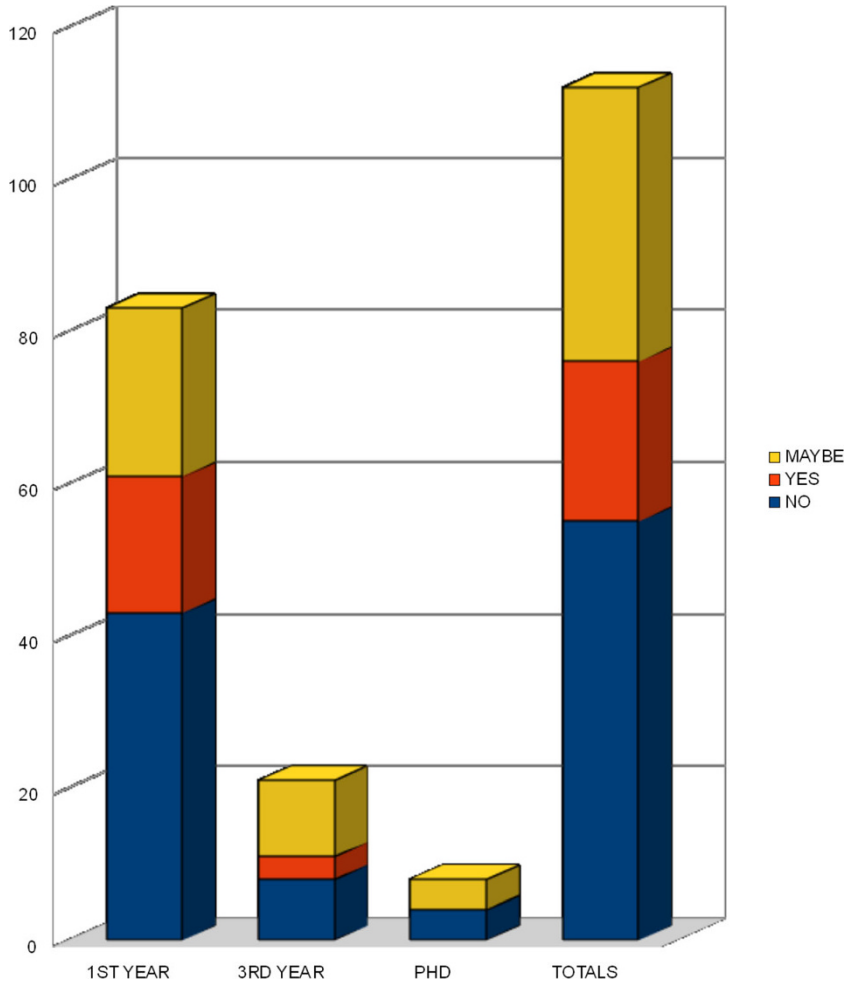

Fig. 6 Question 4: Do you think there is any difference if a robot is conceived by a male or by a female scientist?

difference". AI is another type of intelligence, and it should not be reduced to the human range. Kevin Warwick has elaborated greatly on this aspect, in his view: "We need a viewpoint on AI that is much less anthropomorphic than the classical AI" [72]. To clarify what Warwick means by this, we have to recall the human-centrism of classic AI, to which the final prototype of intelligence is human intelligence. Another simple and direct answer was: "It can be thought of as related to a toaster: a machine needs no gender". The ones who might still need gender attributes are the humans, in order to better interact with the machine. I would like to quote one last "No" response to question 3: "No AI would ever be able to produce sperm nor knit a baby in the womb". This observation leads to a reflection on the sexual interaction between humans and robots. David Levy [45], for instance, thinks that humans will be marrying robots in the near future. The fact that no biological reproduction will result from such an exchange may be seen as unproblematic by many: already at present, numerous human couples cannot, or decide not to, procreate.

This is one of the answers responding to "Maybe": "I feel more women should be involved in the development of AI tools. I feel men in AI are obsessed with 'creation', whereas, because women give birth, women in AI are more concerned with building effective tools which enhance humans". This perspective offers an interesting twist to common biases on female scientists. Their ability to procreate is not seen as an obstacle which might cause them to give priority to building a family instead of pursuing scientific research, as a widespread prejudice recalls. On the contrary, such a capacity is presented as an epistemological advantage, which may allow women to focus on creating "effective tools which enhance humans", rather than trying to guarantee themselves a symbolic progenies through their researches. This reflection implicitly refers to Moravec's "Mind Children", in which he states:

> "Unleashed from the plodding pace of biological evolution, the children of our minds will be free to grow to confront immense and fundamental challenges in the larger universe. We humans will benefit for a time from their labors, but sooner or later, like natural children, they will seek their own fortunes while we, their aged parents, silently fade away". [51]

Such an oedipal view, sustained by the dualism "us/them", fails to include concepts such as empathy or care, which characterize the relationship parents/children in the history of affection. Some feminist theorists have elaborated on this recurring metaphor. Adam, for instance, remarks on the notion of "playing god in the creation stories of the artificial A-Life worlds".[12] From a psychoanalytical perspective, it can be suggested that a womb envy [32] may be motivating this type of researcher.

Question 4 received a light predominance of "No", followed by "Maybe", and lastly by "Yes". Among the answers motivating the "Yes", one of the respondents wrote: "A robotic fridge that targets people and throws beer to them is far more likely to be a male invention. So gender can affect the purpose of a robot". Even though this example might seem trivial, I would like to briefly reflect on it. The relation between inventions and inventors is not easily predictable, but is still sustained by context and experience. Layne, for instance, remarks on how "the life experience of a designer informs every aspect of design, including problem identification and selection" [43], consequently, "it is more likely that feminist technologies will be designed by women" (*ibidem*). Before moving to the next question, I will quote two more answers, one formulated on the "No": "People like to revolve around standardized robots"; one on the "Maybe": "Depends if the scientist sees differences in gender roles. This difference may unknowingly come out in their work". While the former reflection underlines the importance of establishing a common code which humans can employ to interact with different kinds of robots, the latter stresses the urgency for scientists to situate themselves, in order to be aware of the limitations that their standpoints might bear.

Futuristic gender

Postgenderism[13] refers to an hypothetical phase of the future during which the human sexual difference might be voluntarily overcome through the application of advanced biotechnologies. Although the term was first found in "A Cyborg Manifesto" (1985),[14] Donna Haraway has stated: "I have no patience with the term 'post-gender'. I have never liked it" [26], as she explains:

> "Gender is a verb, not a noun. Gender is always about the production of subjects in relation to other subjects, and in relation to artifacts. (…) Things need not be this way, and in this particular sense (…) I approve of the term 'post- gender'. But this is not 'post-gender' in a utopian, beyond-masculine-and-feminine sense, which it is often taken to mean". [26]

I am offering a brief genealogy of the term because, although its semantics might suit the reflections which led me to conceive question n. 5, its pragmatics do not comply with them; actually, the current narratives developing the term mostly fall into a techno-reductionism which does not take into account the cultural and social ramifications of gender identity. In the future, gender will most likely evolve into something different, and thus create a "post", which does not imply obliterations, assimilations or neutralizations. Such an evolution might as well provide a multiplication of genders, not necessarily related to the feminine and masculine archetypes. The answers given by the students were mixed, reflecting the number of possibilities opened by such a question.

One of the responses given to formulate on the "Yes" was: "It will remain as significant as it has always been, but individuals will have more choices as to whether they want to be identified as male or female". This answer points out a constitutive aspect of virtual reality. The possibilities related to experimenting with different digital identities, and specifically, to gender-role playing, have been widely discussed by Cyberfeminism since the Nineties, highlighting both its potentials and its limits. For instance, in her book "The War of Desire and Technology at the Close of the Mechanical Age" (1995), Sandy Stone, elaborated on the case of "Julie", a man who created a well respected female identity online [62]: the negative reception his "true" identity was met with by other on-line participants demonstrated the gap between social expectations and the possibilities inscribed within the virtual realm. More in general, on the relation between identity and technology, it is interesting to observe the development of the thought of Sherry Turkle, one of the pioneers focussing on the sociology and psychology of the growing impact of virtuality on the constitution of human identity. From her enthusiastic work "The Second Self: Computers and the Human Spirits" (1984) [65], in which she pointed out how computers cannot be seen as external tools, but are part of the social and personal life of their users, to "Life on the Screen: Identity in the Age of the Internet" (1995) [66], in which she debated that computers affect the ways humans see themselves as humans; to her last work "Alone Together: Why We Expect More from Technology and Less from Each Other" (2011) [67], in which she argues that social media represent more of an illusion of companionship rather than authentic communication. Back to our questionnaire, let's present two more answers given to

[12] Adam dedicates the subchapter "A Meat-Free Existence" entirely to these aspects [1].

[13] Postgenderism [18] should not to be confused with transgenderism, which, in a very general way, can be defined as not conforming to gender norms; nor with transsexuality, which is related to the sexual reassignment surgery [53].

[14] Specifically: The cyborg is a creature in a postgender world: it has no truck with bisexuality, pre-Oedipal symbiosis, unalienated labor, or other seductions to organic wholeness through a final appropriation of all the powers of the parts into a higher unity. In a sense, the cyborg has no origin story in the Western sense. [24]

motivate the "Yes": "As logic and emotion develop in machine learning I believe gender will have a stronger influence", and "The 'gender' of an AI would affect how humans interact with it and thus it would become significant". The role of gender is reaffirmed both for machines, in their process of identity formation, and for humans, in their interaction with the machines (Figs. 7 and 8).

Consider some of the following quotations from the respondents who answered "No": "I would hope that over time, sexism and gender stereotypes will disappear"; "As it becomes more and more common to design ourselves (think what plastic surgery will be like in 50 years) or to abandon our original bodies entirely (mental uploading etc.), gender will become obsolete". The term "obsolete" recurs in posthumanist and transhumanist literature, and needs a brief genealogical introduction. The first person to employ it in such contexts was the Australian artist Stelarc, who notably stated in various occasions: "the body is obsolete". In his text "From Psycho-Body to Cyber-Systems: Images as Post-Human Entities" (1998), he explains: "It is time to question whether a bipedal, breathing body with binocular vision and a 1400 cc brain is an adequate biological form" [60]. He has gone so far as proposing a "Third Life" [36, 61], where the Second Life formula of biological bodies extending their potentials through avatars will be reversed: in "Third Life", avatars will be performing in the physical realm through various biological bodies.[15] Warwick himself has echoed Stelarc, referring to the possibility of developing a technology which will make telepathy possible: "Speech, as we know it, may well become obsolete" [71]. I will conclude this section by mentioning one of the "Maybe" responses: "Technology will eventually level the gender difference with regard to abilities and chances, but opinions need to change first". Technology is a constitutive aspect of the human: its achievements are not separated from the social and cultural contexts in which they are generated and employed.

When I formulated this question, I was intrigued to learn what the respondents thought in regard to the advantages brought about by their research in gender terms. This is an aspect which is hard to foresee, as Layne remarks: "Some feminist technologies are feminist by accident; that is, the benefit for women is an unintended consequence" [43].[16] The most common answer submitted was: "I don't know", followed by "Male", and then "Female". The following reason was offered by one respondent who answered "Male": "Female's tasks usually have to have a flexible approach and hence are difficult to 'automate' ". The same point can also apply to the opposite view. For instance, Genevieve Bell, while working as an anthropologist for Intel, recalls her surprise when, doing a research on early adopters of Wi-Fi and wireless technology, discovered that women were in fact the early adopters. She identified the reason specifically in such a flexible approach, and in the fact that women's lives are generally characterized by larger amounts of multi-tasking [43]. Among the other answers given to this question: "There are more male engineers working on this field" and "Most major breakthroughs are supported by military funding: most armed forces are made up primarily of males". The latter observation emphasizes a crucial aspect not yet touched upon. The military funding has had a key role in scientific research since the early 20th century, starting with World War I and increasing massively with World War II [48]. Computer sciences were almost entirely funded by the military in the first decades of their development [13]. As of today, AI programs are still largely funded by defense money, which contributed, for instance, to the widely expanded military use of the unmanned aerial vehicles (UAV) (commonly known as "drones") in the last decade, along with controversies about the growing number of civilian casualties caused by them [63]. Following are some of the reasons given by the people who answered "Female": "Women live longer than men and so will need to be cared for more at old age"; "Females have higher incidence of Alzheimer disease". Both answers resonate with the fact that much research is being currently invested in developing robots capable of assisting with activities of daily living. For instance, Pearl was developed at the Carnegie Mellon University in 2004,[17] as a nursebot that could help the elderly at home. From a gender perspective, it is worth noticing that Pearl was given a female persona, and that part of the scientific challenge was "studying people's responses to a robot's perceived gender by changing Pearl's lips and voice" [11]. The role played by aesthetics was crucial in developing Pearl, and it may as well be seen as determinant for any robot built for social purposes. Another answer to question 6 was: "Robots with AI can do all of the housework which is predominantly done by women". House-bots have actually proven to be harder to develop than expected. One of the reasons commonly given is that housework is more resistant to automation because it is characterized by constant interaction with different objects of unpredictable shapes; on the contrary, the assembly line in a factory, for instance, consists of repetitive work accomplished with the same type of objects. From a feminist perspective, such a slow advance may be perceived as the result of a lack of interest in developing technologies which would comply with tasks traditionally done by women. Nowadays, the increasing number of single men and of the elderly population in the Western world has given priority to such a commitment, with successful

[15] The risk of Cartesian dualism in Stelarc's accounts has been pointed out by John Appleby [2].

[16] As an example, Layne mentions the innovations which followed the American with Disabilities Act (1990): making public spaces accessible to people with motor impairments was beneficial also to those who use strollers [43].

[17] Professors Sara Kiesler and Sebastian Thrun led the team project.

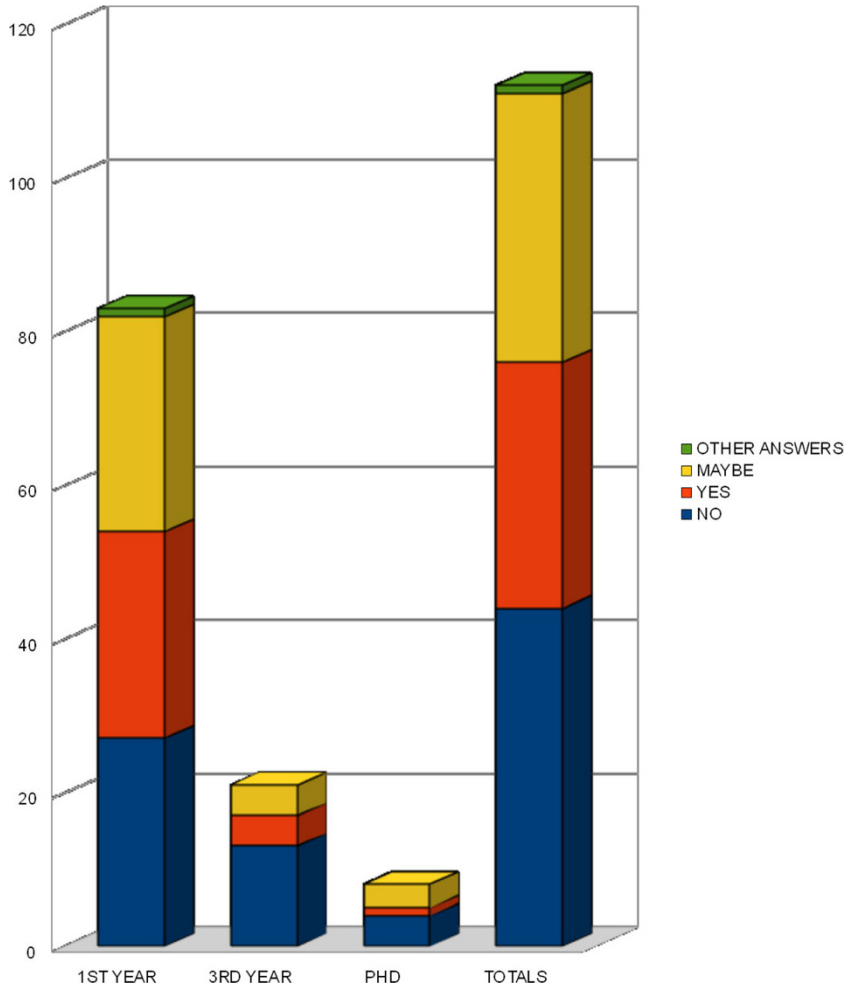

Fig. 7 Question 5: Do you think of gender as a significant category in the future?

results such as Roomba, the autonomous robotic vacuum cleaner commercialized by iRobot since 2002.

Races and ethnicities

There is no gender separated from race, ethnicity, age, sexual orientation, and many other social and individual differential categories, as the intersectional approach has pointed out [15]. Not having had an opportunity to formulate on this aspect in the questionnaire, I decided to pose one question specifically on the subject of race and ethnicity. A problem I immediately faced was scientific terminology. In Europe the term "race"[18] has not been reappropriated the way it has been within the US academic debates of the last decades, where the social construction of the term is a given which does not have to be remarked each and every time. Because of the fact that my research was pursued at the University of Reading (England), I decided to include in question 7 both notions of "race" and "ethnicity" - the latter one is often employed in the European political discourse to avoid racist connotations, thus risking, on the other side, to silence the issue of racism itself. I would also like to stress the fact that, within a posthumanist frame, race and its intersections with gender, class, and other categories, have yet to be fully addressed (Fig. 9).

The responses given by the students were mixed. These are some of the answers formulated on the "Yes": "Advanced AI (one that could beat the Turing Test[19]) will need to have some degree of culture associated with ethnicity"; "The assumed personality of the AI will affect its reception by certain social groups". As in the case of gender, race is perceived as significant in its hermeneutical role. Humans relate to AI through human knowledge, which is structured through categories and beliefs. As Michael Omi and Howard Winant have pointed out:

> "Everybody learns some combination, some version, of the rules of racial classification, and of her own racial

[18] For an account on the use of the term "race" in different European countries, see the section "Lets' Talk about Race", [46].

[19] The Turing Test was proposed by Alan Turing in his paper "Computing Machinery and Intelligence" (1950), with the purpose of answering the question "Can machines think?" [64].

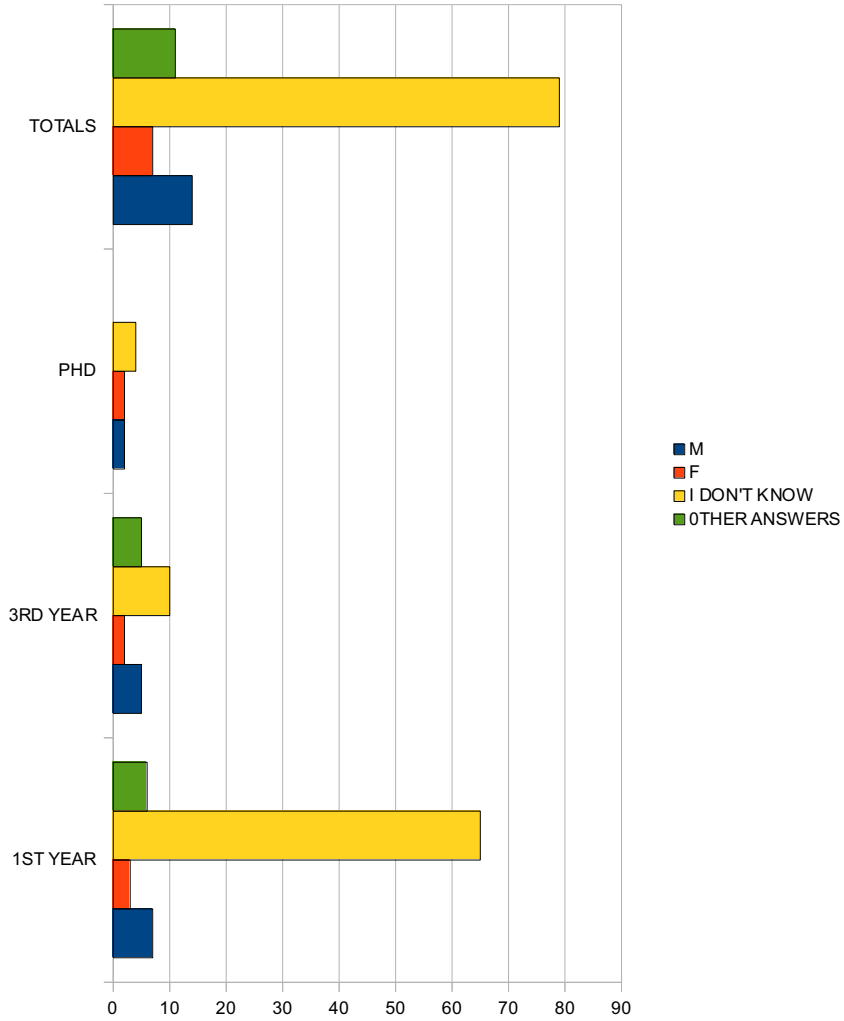

Fig. 8 Question 6: Do you think that one of the two biological sexes will be more advantaged by the creation of AI?

> identity, often without obvious teaching or conscious inculcation. (…) Race becomes 'common sense' - a way of comprehending, explaining, and acting in the world". [55]

Far from being immune from these unwritten laws, science has actually held an active part in directing and legitimizing them: for instance, in the 19th and 20th century, the scientific claim of racial superiority was popularized by what will be later defined as social darwinism [22, 31]. Some other answers given as "Yes" remarked on the risk of ethnic and economic disparities being perpetrated: "The robot body will also be provided with voices and accents which will probably be American" and "The subjects of countries (the richest one) will get first access to these technologies". The limits of technology in terms of accessibility has been pointed out by postcolonial and posthumanist theorists. Katherine Hayles, for instance, notes how "the techno-ecstasies found in various magazines" refer to "the transformation into the posthuman as if it were a universal human condition when in fact it affects only a small fraction of the world's population" [29]. It is also important to stress that the ethnic features given to the robots (for instance, "voices and accents which will probably be American", which I would rephrase as "white American") represent a form of neo-colonization that should not be underestimated.

The following answers were articulated on the "Maybe": "Human-like robots will look like the country they have been created, e.g. in Japan they look and speak Japanese"; "Intelligence may be defined and seen differently depending on race and culture. Hence when AI is developed, the way of understanding it will be very different". Humans relate to AI through human categories of comprehension, but these same categories may differ, depending on cultures, nationalities, social, political and religious backgrounds. For instance, in 2010 Japan hosted the first wedding conducted by a robot priest [5]. Naho Kitano, in his article "Animism, Rinri, Modernization: the Base of Japanese Robotics" (2007) [39], associates such an open-mindedness about the spiritual relevance of robots, to the animist component of Shintoism. As early as 1974, Masahiro Mori, one of the Japanese pioneers of Robotics, presented robots as spiritual beings eligible for attaining

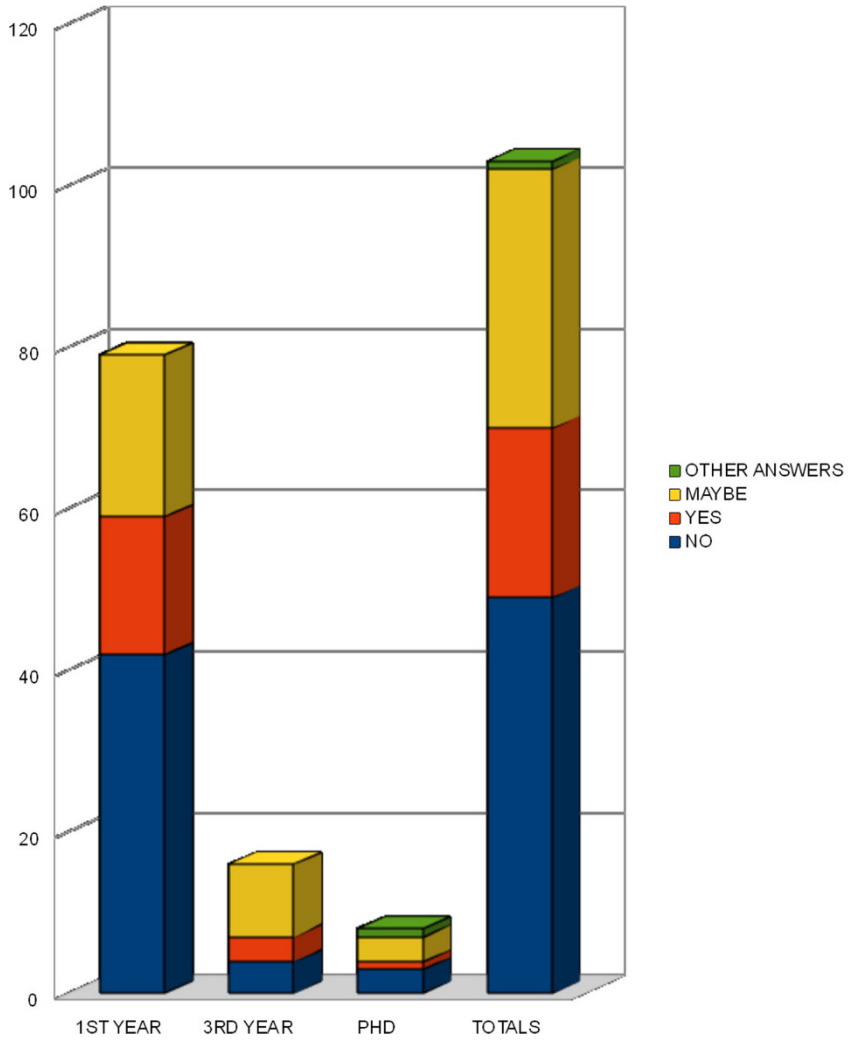

Fig. 9 Question 7: Do you think that concepts such as race and ethnicity will be significant in the development of AI?

buddhahood [52]. Cultural beliefs play a crucial role in the reception and development of advanced AI, so that, while in the West robots are portrayed as the new "other" which might rebel and try to take over the world, like the golem in Jewish folklore or Mary Shelley's Frankenstein [58], in Japan they partake of the spiritual quest. Some of the answers formulated on the "No" were: "Market must be international! They won't spend fortunes with any ethnic limitations", and "Race and Ethnicity are very abstract concepts. There have always been males and females. Borders and religions always change". The former response underlines the centrality of economic profits in scientific developments. The latter points out the fact that race and ethnicity are not fixed notions, but are always changing, resonating with Omi and Winant's view of race as a fluid and dynamic social construct [55]. At the same time, this answer presents gender in a static way, while the concepts of "female" and "male" are constantly performed and re-enacted [10]. Such results highlight the need for a deeper investigation in the topic of race, ethnicity and their intersectional significations in the development of technological futures.

Concluding remarks

Is the "post-human" a "post-woman"? This is a crucial question from a feminist perspective rooted in a posthuman approach. This research made it clear that the seeds of the futures are gendered, in the ways they are currently being conceived and actualized. On one side, the questionnaire results reveal AI as a field which is developing under a predominantly male imagination: for instance, while the cyborg was thought of as neutral or male by the majority of respondents, none of them thought of robots in feminine terms. On the other side, gender as a social code seems to resist its biological legacies. Even if sex will have no biological or physiological relevance for robots, in the future gender will be reaffirmed in its hermeneutical role, and precisely: for machines, in their process of identity formation; for humans, to better interact with the machines.[20] The relationship between humans and robots

[20] From the results, a similar reflection seems to apply to race as well, even though such an investigation needs further statistical analyses.

has attracted much attention from the interviewees. In respect to humans, robots are, at the same time: the other, the same and the chimera. They can communicate in a human code without being human; they can hold a mechanical body and a biological brain (think of biological AI); they have been constructed from human knowledge and categories, and still, they transcend them both. Cultural beliefs play a key role in the human reception of advanced AI, while political, social and economic interests are crucial to its developments.

Robots are going to evolve in unique and peculiar ways, which are hard to predict. The main risk run by humans consists in turning the robotic difference into a stigma for new forms of racism, based on how far such a difference can be placed from the human norm. To osmose with the robot ontology, humans have to undergo a radical deconstruction of the human as a fixed notion, emphasizing instead its dynamic and constantly evolving side, and celebrating the differences inhabiting the human species itself. For this reason, employing critical frames such as Feminist Epistemology, the Philosophy of Sexual Difference, Critical Race Theory, Postcolonial Studies, Queer Theory, Disability Studies and Intersectionality, among others, is seen as crucial in the development of posthuman epistemologies informing the technological fields. Adopting such standpoints will allow humans to generate an emphatic approach, preventing them from turning the robot into their new symbolic other, and from falling into the dualistic paradigm which has historically characterized Western hegemonic accounts, articulated in opposites such as: male/female, white/black, human/machine, self/other. A thorough reflection on this interaction among species relocates the discourse within a symbiotic paradigm, rather than a dualistic one. The difference becomes an evolutionary trait of existence; such a realization has not only scientific value, but also social and political utility. In the futures, the integral onto-epistemological approach of the posthuman may allow humans and robots to fully develop their interconnected potentials, eventually facilitating an original interspecies venture into the existential quest.

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